



A.D. 1820 N^o 4472.

S P E C I F I C A T I O N

OF

JOHN WAKEFIELD.

FURNACES FOR BOILERS.

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Furnaces for Boilers.

WAKEFIELD'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JOHN WAKEFIELD, of Ancoat's Place, Manchester, in the County of Lancashire, Engineer, send greeting.

WHEREAS His most Excellent Majesty King George the Fourth, did, by
5 His Letters Patent, under the Great Seal of the United Kingdom of Great Britain and Ireland, bearing date at Westminster, the Sixth day of June, in the first year of His reign, give and grant unto me, the said John Wakefield, my exors, admors, and assigns, His especial licence, full power, sole privilege and authority, that I, the said John Wakefield, my exors, admors, and assigns,
10 during the term of years therein expressed, should and lawfully might make, use, exercise, and vend, within England, Wales, and the Town of Berwick upon Tweed, my Invention of "CERTAIN IMPROVEMENTS IN THE CONSTRUCTION OF FURNACES FOR BOILERS OF VARIOUS DESCRIPTIONS, AND IN THE MODE OF FEEDING THE SAME WITH FUEL, WHICH IMPROVEMENTS ARE CALCULATED TO LESSEN THE CON-
15 SUMPTION OF FUEL AND TO BURN THE SMOKE;" in which said Letters Patent there is contained a proviso obliging me, the said John Wakefield, by an instrument in writing under my hand and seal, to cause a particular description of the nature of my said Invention, and in what manner the same is to be performed, to be inrolled in His Majesty's High Court of Chancery within six
20 calendar months next and immediately after the date of the said recited Letters Patent, as in and by the same, relation being thereunto had, may more fully and at large appear.

Wakefield's Improvements in the Construction of Furnaces for Boilers, &c.

NOW KNOW YE, that in compliance with the said proviso, I, the said John Wakefield, do hereby declare that my said improvements in the construction of furnaces for boilers, and in the mode of feeding the same and burning the smoke, are particularly described and specified in manner following, reference being had to the Drawings hereunto annexed, and to the following general 5 description of a furnace in which my said improvements are introduced, and in which description the letters and figures of reference, when found in more than one of the said Drawings, indicate the same parts in all in which they are so found.

General description of a furnace in which my said improvements are 10 introduced:—*a, a, a*, the breast (often called the bridge) behind the fire, which operates to force up the flame and heated air into close contact with the bottom of the boiler while passing from the fire to the flue; this is common to many furnaces for boilers that are constructed with any degree of skill. The said breast goes quite across from side to side, and is parellel with the 15 front of the furnace; *b, b, b, b, b, b*, the cheeks placed behind the breast *a*, and which (like the said breast) tend to retard the flame and heated air, and to allow it more time to give off its heat to the boiler. Before the date of the said Letters Patent I was in the practice of introducing cheeks behind the breast at right angles to the sides of the bed (or bottom part of the flue), but 20 now I make the cheek next to the said breast to decline from the said breast as it, the said cheek, recedes from the side, and those cheeks which are further from the said breast to incline towards it, as shewn in the Drawing D. These cheeks extend from the sides to a little way beyond the central longitudinal line of the said bed. The said inclination given to the said cheeks makes 25 them perform their intended office better than when they are at right angles to the sides; and this is one of my said improvements for which I have obtained the said Letters Patent. The number of these cheeks is sometimes increased to four or five, or even six, when the boiler is of considerable length. *c, c*, the curb; this curb, which rests on the breast *a*, and projects from the 30 said breast towards the fire, serves to impede the unconsumed smoke, which would otherwise pass off as quickly as possible towards the flue along with the hot air, which (having in its passage through the fire parted with its oxygen, is no longer able to maintain combustion), and so would escape without performing its duty; but the smoke being thus impeded, and at the same time met by 35 a supply of fresh air poured in by the blowers *m, m, m, m, m, m, m*, (hereafter described), is at once urged back on the fire and furnished with oxygen to effect its combustion; *d, d, d, d, d, d*, the curved sides of the furnace. These curved sides, as they rise from the bottom of the furnace, are made to incline

Wakefield's Improvements in the Construction of Furnaces for Boilers, &c.

towards the centre of the furnace, making the furnace widest at the bottom contrary to the common practice. By this contrivance the flame and smoke as they ascend are urged (by the current of heated air ascending with them) to take a course somewhat across the fire and the bottom of the boiler, instead
5 of passing off at once in a straight line towards the flue, thus giving an increase of temperature to the smoke, and putting it in a condition to be partially ignited by any air that may have escaped decomposition by the rapidity of its passage through the fire. This improvement was first introduced by myself; but having used it openly before the date of the said Letters Patent, I do not
10 claim it as any part of the said grant. For brevity, these curved sides are usually called the curves. *e, e, e, e,* the jambs projecting from the sides of the furnace at the inner or farther end of the fire bars or grates, so as to there close the curves (*d, d, d,*) perpendicularly from the top of the said curve to the bottom of the furnace. These jambs co-operate with the said curves in forcing
15 the flame from the sides to cross the fire before passing off to the flue; *f, f, f, f, f, f,* the flues. I build my side flues (being those parts of the flues which pass along the sides of the boiler) wider at the bottom and narrower at their upper part (see Drawing B) than is the general practice, thus giving more room for the dust to lodge in at the bottom without impeding the draft, and
20 thus forcing the hot air in its passage to the chimney to press more closely against the sides of the boiler at the upper horizontal part of the flue, which traverses that part of the boiler which is farthest removed from the direct influence of the fire. But though I wish here to call the attention of the builder to the circumstance as conducive to the effects aimed at in a well con-
25 structed furnace, I do not claim it as one of my said improvements, having used it publickly before the date of the said Patent. *g, g,* the boiler; *h, h,* the fire bars. I lay my bars farther apart at their further extremity and nearer each other in the fore part of the grate than is the common practice, according to which common practice the bars are laid parellel to each other. I was
30 the first person that introduced this improvement, but it is not claimed by me under the said Patent, having before the date thereof made it public. The advantage attending it are these: the bars being near each other in the front prevent the small coals from passing through when the fire is fresh fed, so that they get coked together before being pushed back to the hinder part of the
35 grate, and the bars at the hinder part being more asunder, admit more air where there is less danger of the coals falling through, as they are run into larger masses before they reach that part of the grate. But I have since introduced another improvement, which forms one of the said improvements included in the said Patent. Instead of laying all and every of the fire bars

Wakefield's Improvements in the Construction of Furnaces for Boilers, &c.

opening wider from each other at their further ends than in front (as shewn in the Drawing D), I now lay from three to six of the fire bars (according to the width of the fire grate) parallel to each other on each side respectively of the furnace, laying only the intermediate bars in the manner shewn in the Drawing D. The reason why these three, four, or more bars on each side 5 respectively are laid parallel to each other on the side to which they belong, is for the purpose of allowing the teeth of what I denominate the grate rake (which will be hereafter described) to move freely along between the bars at the side of the grate. *i, i, i*, doors, which open into the horizontal flues for the convenience of cleaning them; *k, k*, the fire door; *l, l*, openings for the rods, 10 by which the slides or other contrivances are made to open or shut the apertures for admitting air into or excluding it from the air flue or flues, or into or from the blowers, to be hereafter described. *m, m, m, m, m, m, m*, blowers in the breast *a*, under the curb *c, c*, which pour in air from the cross air flue *1, 1*, to supply oxygen for inflaming the smoke, which would otherwise escape uncon- 15 sumed into the flue. These may be of any convenient number, and wider or narrower in their apertures, or instead of many, one long aperture may be employed; ^x*m, m, m, m*, side blowers for the same purpose; *1, 1*, the cross air flue supplied with air from the ash-pit. In the upper part of this flue are openings, (which I call the blowers *m, m, m, m, m, m, m*,) allowing air to 20 pass from the flue into the furnace, and which admit fresh air for igniting the smoke, as mentioned above. *2, 2*, side air flues, also supplied with air from the ash-pit, and terminating at their upper ends in the blowers in ^x*m, m*, for throwing in streams of air into the sides of the furnace to supply oxygen for the combustion of the smoke; sometimes I have only one of these side flues 25 (^x*m, m*, Drawing D,) on each side of the furnace, some inches forward from the further end of the bars; but when the furnace is large, I introduce one more, (*n, n*,) on each side for the same purpose, still further forward; *3*, the ash-pit. Having thus (for the purpose of rendering this Specification perfectly intelligible to any moderately skilled workman) given a general description of 30 a furnace in which the said improvements for which I received the said Letters Patent are introduced, I now proceed to enumerate more particularly in what the said improvements consist, namely, first, the blowers (*m, m, m, m, m, m*, Drawing B, and *m*, Drawing C); and here let it be observed, that these blowers produce a much greater effect from being directed against the fire 35 than if openings from the cross air flue (*1, 1*,) were allowed to blow straight up against the bottom of the boiler; for, in the latter case, if the smoke has not acquired sufficient temperature to permit inflammation before it reaches the curb,

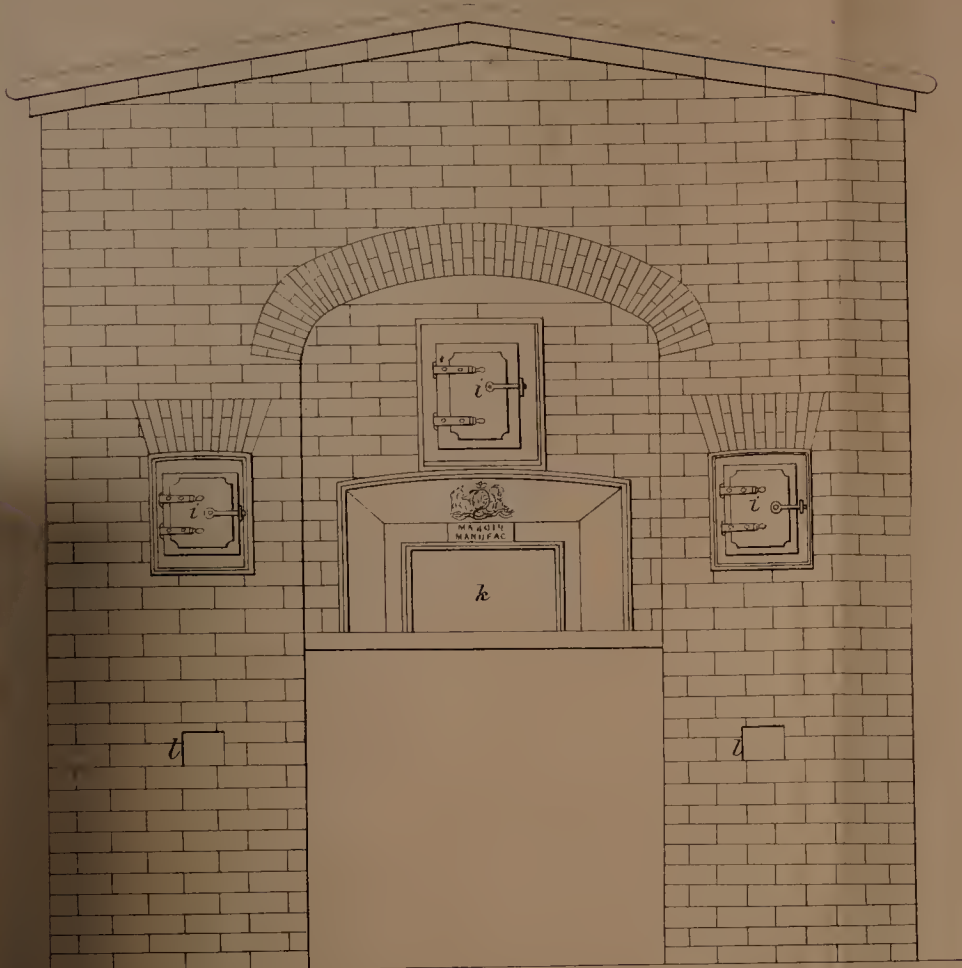
Wakefield's Improvements in the Construction of Furnaces for Boilers, &c.

it will notwithstanding this access of air pass off to the flue unconsumed, and the streams of air directed against the bottom of the boiler will only prove an evil instead of a benefit, by tending to cool the boiler; and further, when it is attempted to remedy this cooling (that arises from such streams of air beating
5 on the bottom of the boiler) by interposing supported tiles over the openings from the cross air flue, though this will prevent such streams of air from beating directly against the bottom of the boiler, still a portion of the smoke may escape combustion from want of temperature. But by the direction which I give to my blowers, the air which they pour into the furnace beats back the smoke, which
10 after reaching the breast has to get over the curb; and the direction of the streams of air so operating with the curb, forces the smoke back upon the fire, where it requires temperature sufficient to insure complete combustion and to convert it into flame before it can escape to the flue. By thus entirely consuming the smoke, it becomes fuel, and thus effects the saving of coals. Second, the in-
15 clined cheeks (*b, b, b*, Drawing C, and *b, b, b*, Drawing D,) the foremost of which allows the hot air and flame to pass with less interruption than those behind that part of the boiler, being nearer to the direct influence of the fire and of the flame passing over the breast and the curb; but those further removed from the fire have a contrary direction given to them that they may the more
20 effectually cause the flame to give off its heat to the boiler at the part farther removed from the fire. These cheeks (like the breast) are topped with curbs projecting towards the fire, that they may more effectually perform their office. Third, the bars laid parallel at each side respectively of the fire grate. These have been so fully described, that their position cannot be misunderstood;
25 though those on each side are parallel to each on the same side, yet those on the one side are not parallel to those on the other side; those on the one side being necessarily obliged to diverge at their further extremity from those on the other side of the fire grate, owing to the disposition of the interposed bars. Fourth, the grate rake; this is in form somewhat like the instrument from
30 which it is named, being composed of an iron cross bar at the end of a long iron handle, of sufficient strength, which cross bar is furnished with from three to six iron teeth, (according to the size of the grate,) placed at distances from each other, corresponding to the distance of the bars, standing up vertically, and of such a length that when the said cross bar is raised up, to touch the
35 under side of the fire bars, the said teeth may reach three or more inches above the upper side of the said bars. The head of the rake (namely, the said cross bar with the said teeth) when used, is placed about third way from the near to the far end of the bars; the teeth are then raised through the bars into the fire, and being then slidden backwards, carry with them the principal

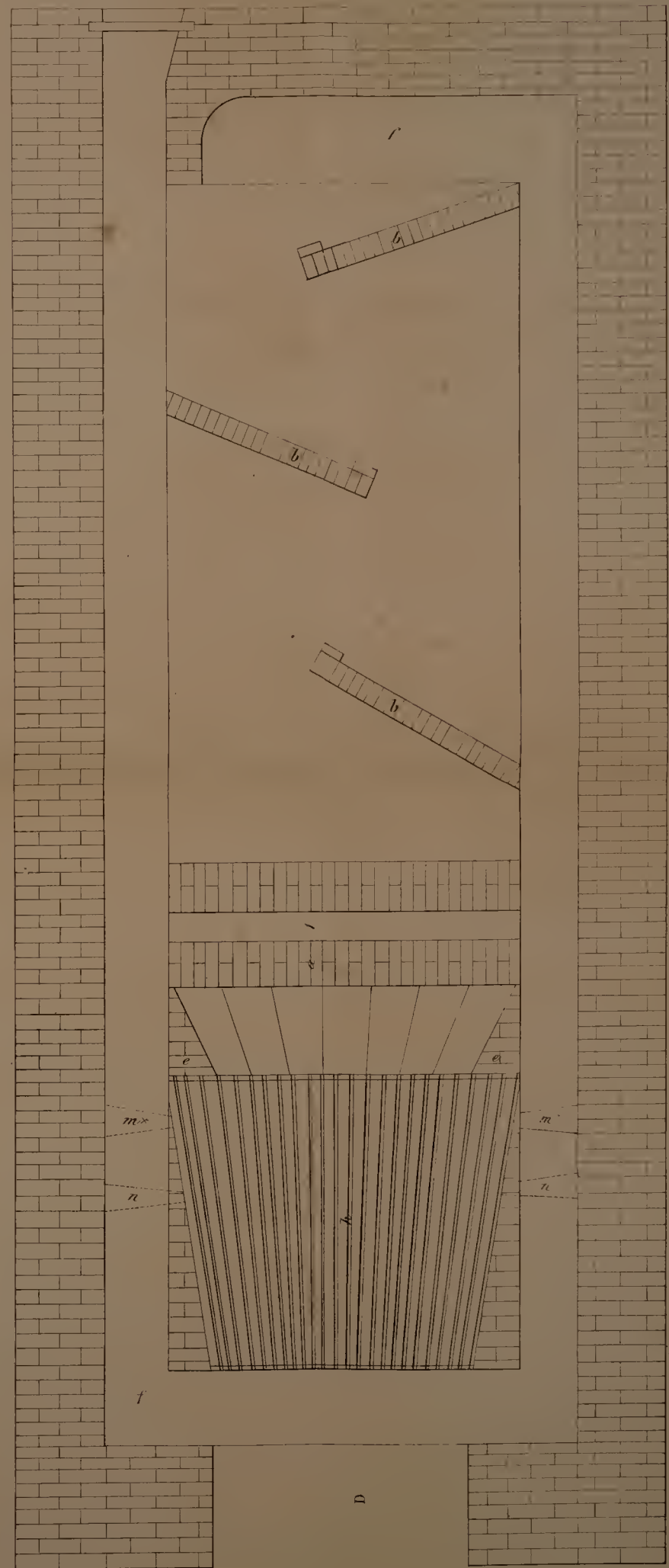
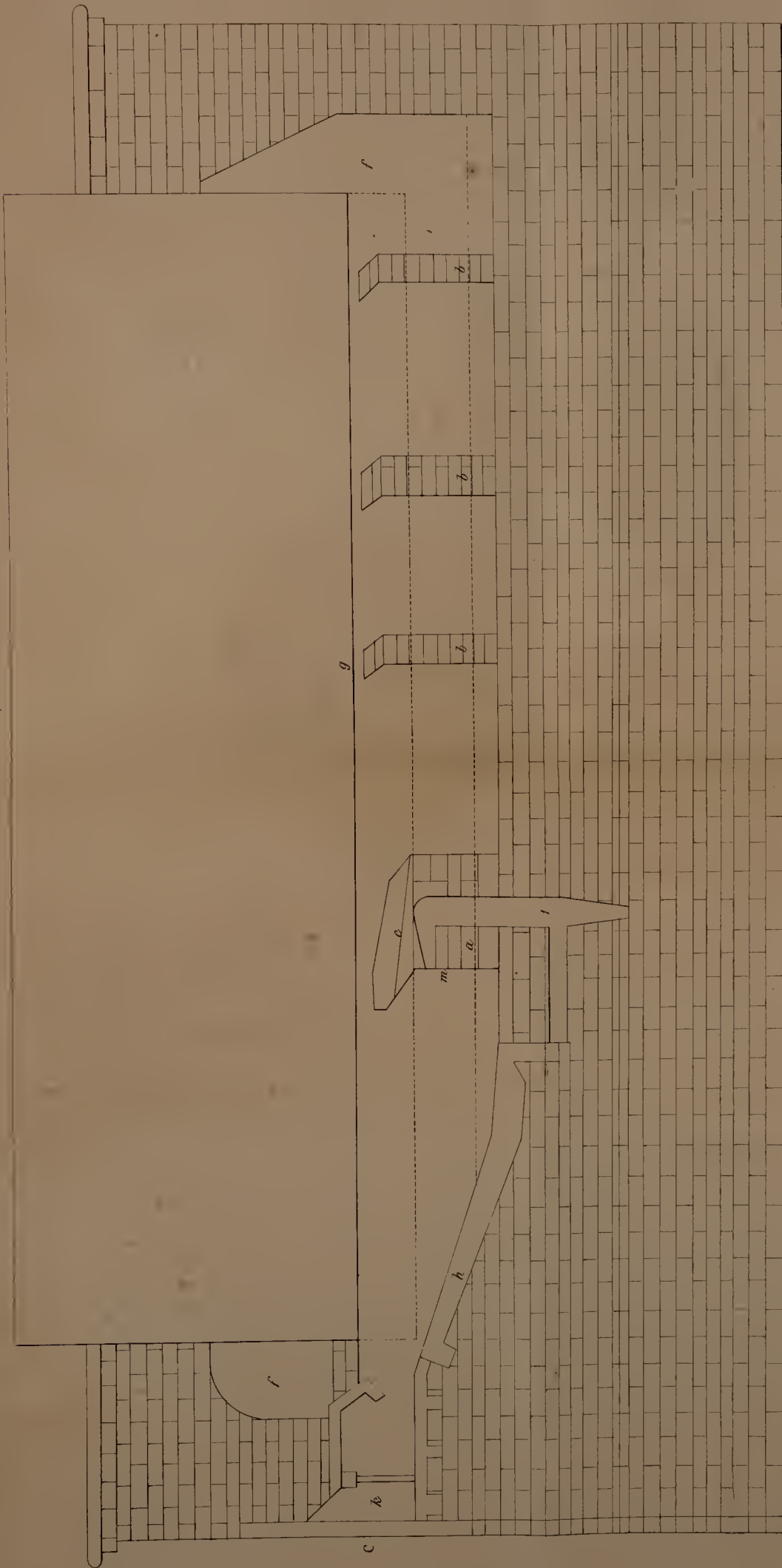
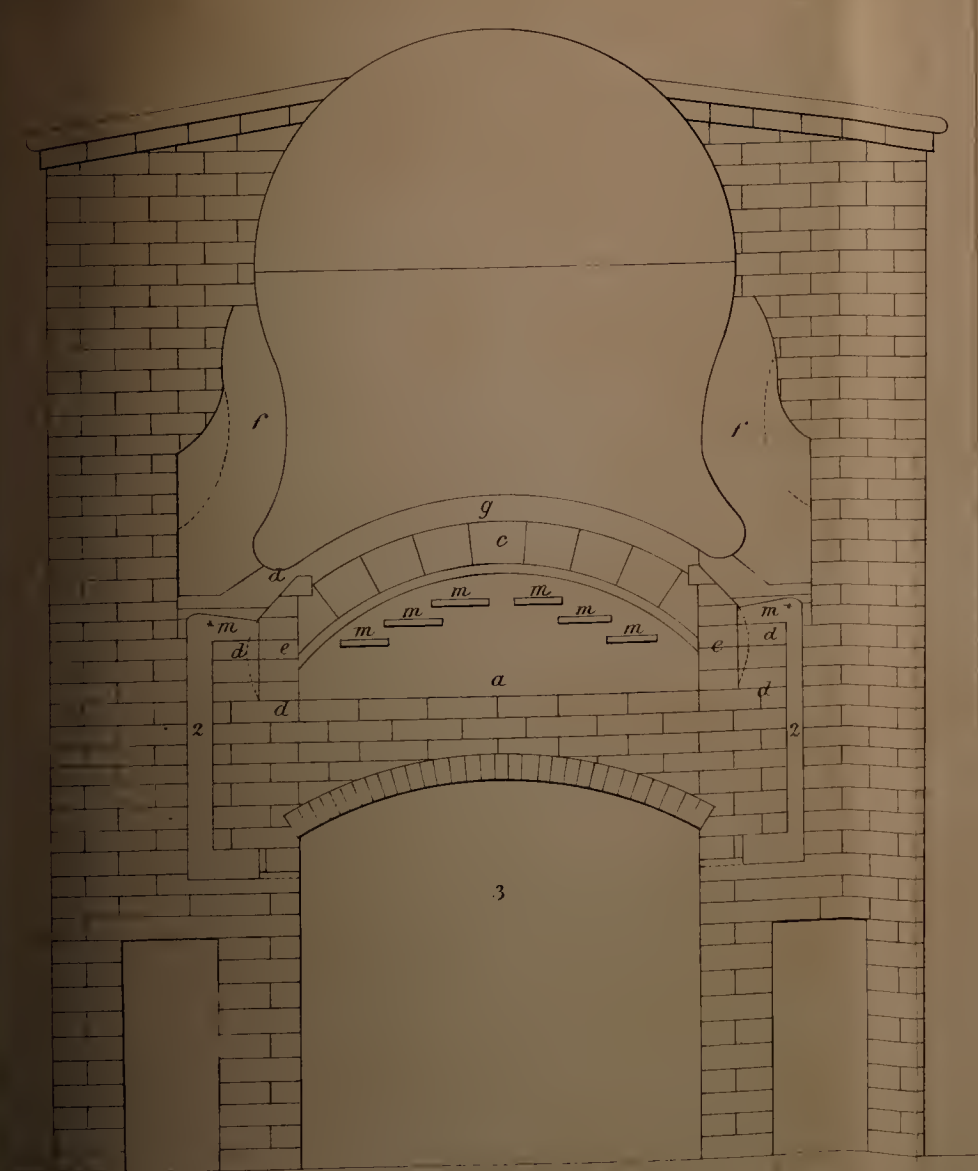
Wakefield's Improvements in the Construction of Furnaces for Boilers, &c.

part of the cokes which were lying on the bars that are thus raked, and deposits them at the further end of the fire bars, before I proceed to feed or renew the fire ; and I manage the feeding in the following manner. Having, as I have just described, pushed back the fire that was on the parallel side bars to the further end of the said bars, the next step is to spread the fire 5 that is on the middle of the grate to the sides and towards the breast, after which fresh fuel is introduced on the middle of the grate, and by this means I maintain flame at the sides of the grate rising under the said curves (*d, d, d,*) sweeping over and heating and inflaming the smoke, which always rises most abundantly on the introduction of fresh fuel. The said grate rake is made to 10 run in and out on a roller, in the same manner as the common pricker which has been long in use for opening the fire bars to let air into the fire ; but sometimes, when the size of the furnace is such as to make the use of mechanical means desireable, I then suspend the pivots of the said roller in vertical grooves, so that the roller may be raised or lowered by means of a lever ; and 15 on one end of the roller I place a toothed wheel, to be driven by a pinion worked by hand by a winch, or by a power borrowed from any convenient machinery on the premises ; or I use any of the well-known mechanical means employed for raising and lowering axles. In this case, the back of what I call the handle of the rake is toothed as a rack, and works in a toothed wheel upon 20 the roller, (or on an axle substituted for the roller,) so that when the roller is made to revolve, the rake is carried with it. The reason for having the rake made to rise and fall, is for the purpose of introducing the teeth of the rake through the bars, and of withdrawing or lowering them again after they have carried back the fire that was on the said parallel side bars ; or instead of 25 using a rack on the back of the handle of the rake, I employ any of the other mechanical means in common use for giving a close reciprocating motion to apparatus requiring a similar movement ; my said improvements referring only to the said grate rake, and not to the means employed to raise and lower it, or move it backward and forward, which may be effected in many ways well 30 known to mechanics. When the furnace is large, I sometimes use two cross bars with teeth upon the same handle, parallel to each other, and six or seven inches or more apart ; and sometimes when the furnace is large, I have a rake for each side of the fire grate. Fifth, the mode of feeding the fire, and which has been so fully described to illustrate the use of the grate rake, that but 35 little needs to be added here. It is known to every person acquainted with the management of boiler furnaces, that in the common method of beating down the fire, that is, preparing for a new charge of fuel, it is usual to spread the fire pretty equally over the bars ; but unless this method be departed from, and

A



B



Wakefield's Improvements in the Construction of Furnaces for Boilers, &c.

that adapted which I have described above, namely, moving the principal part of the fire to the sides and hinder part of the grate before introducing the raw coals, the full benefit of my said improvements will not be obtained. From the foregoing description, any competent workman will be at no loss to apply my
5 said improvements to boilers of other forms, adapting them to the said other forms according to circumstances. When the bottom of the boiler is circular, and especially when of small dimensions, then the cheeks *b, b, b*, may be dispensed with. Lastly, from my flues and other parts requiring particular forms of bricks, I prefer moulding the clay into the requisite forms before burning,
10 instead of cutting burnt bricks into the required shapes. This not only saves time and trouble to the furnace builder, but is advantageous in preventing the risk of flawing the bricks; and besides, I am of opinion that the fire face of the bricks (of whatever form,) is more durable under the action of the fire than new surfaces formed by chipping or sawing; and thus furnaces built with
15 bricks brought into form before the bricks are burnt, will last longer without needing repairs than those built in the common manner. Of course, in making of bricks, I only speak of such furnaces as require bricks; for my said improvements in other respects are equally applicable to furnaces in which iron or other metal or suitable material is employed without bricks, as is sometimes the
20 case for boilers for steam boats.

In witness whereof, I, the said John Wakefield, have hereunto set my hand and seal, this Fifth day of December, in the year of our Lord One thousand eight hundred and twenty.

JN^o. WAKEFIELD. (L.S.)

25 **AND BE IT REMEMBERED**, that on the Fifth day of December, in the year of our Lord 1820, the aforesaid John Wakefield came before our said Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained and specified, in form aforesaid. And also the Specification aforesaid was stampd according to the tenor of
30 the Statute made for that purpose.

STEPHEN.

Inrolled the Fifth day of December, in the year of our Lord One thousand eight hundred and twenty.

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